WHAT IS CLAIMED IS:

1. A method of diagnosing a catalyst, including the steps of:

detecting at least one parameter indicating operating conditions are sufficient for producing reliable diagnostic test results;

determining a first temperature characteristic of the catalyst;

controlling a change in gases' concentrations entering the catalyst so as to provide chemical conditions sufficient for changing the catalyst temperature from the first temperature;

determining a second temperature characteristic of the catalyst; and

comparing changes between the first temperature characteristic and the second temperature characteristic to determine whether the catalyst is malfunctioning.

2. A method according to claim 1, further including the steps of:

determining a first derivative and a second derivative for the first temperature characteristic and the second temperature characteristic; and

providing results for determination of catalyst malfunctioning by using at least one of the first derivative and the second derivative.

3. A method according to claim 1, whereby the step of controlling a change in exhaust gases' concentrations includes controlling a quantity of residual exhaust gases entering an engine's cylinder so as to modify concentrations of nitrogen oxide(s) gases at the catalyst and determining whether the operation of said catalyst is malfunctioning based upon changes between the first temperature characteristic and the second temperature characteristic.

4. A method according to claim 3, whereby the controlling the quantity of residual exhaust gases entering an engine's cylinder is selected only during operational conditions minimizing associated changes in exhaust gases' concentrations of HC and CO gases following the controlled change of residual gas quantities entering an engine's cylinders.

5. A method according to claim 3, further including the step of selecting a catalytic converter design so that the determining whether the operation of said catalytic converter is malfunctioning is more accurately detected.

6. A method according to claim 3, whereby engine power changes caused by said controlling the quantity of residual exhaust gases entering an engine's cylinder are compensated for by use of a device for electrically controlling engine airflow changes based upon operator power demands.

7. A method according to claim 1, wherein determining whether the catalytic converter is malfunctioning uses the first temperature characteristic and the second temperature characteristic for modifying changes in gases' concentrations entering said catalyst from an engine.

8. A method according to claim 1, where a design of a catalytic converter is selected such that the step of comparing changes between the said first temperature characteristic and the second temperature characteristics provide consistent and discernible differences between when the comparing is made using at least one reference catalytic converter known to be malfunctioning and at least one reference catalytic converter that is known to be marginally good.

9. A method according to claim 1, wherein the step of controlling a change in gases' concentrations includes controlling a change in steady state gases' concentrations;

10. A method according to claim 9, whereby the step of controlling a change in steady state gases' concentrations is accomplished by operating selected individual cylinders of an engine under rich conditions while introducing oxygen into exhaust gases entering said catalyst.

11. A method according to claim 9, wherein the step of controlling a change in steady state gases' concentrations is caused by cycling air-fuel ratio characteristics of the gases entering the catalyst so as to provide conditions sufficient for modifying the rate of catalyst heating.

12. A method according to claim 11, whereby the air-fuel ratio characteristics of the gases entering said catalyst are controlled to have frequency and magnitude characteristics selected so as to minimize perceptible changes in engine vibration.

13. A method according to claim 1, wherein the step of controlling a change in gases' concentrations is achieved by changing the amount of fuel flow into an engine cylinder that is coupled to the catalyst.

14. A method according to claim 1, wherein the step of determining a first temperature characteristic includes measuring at least one first instantaneous temperature point and the step of determining a second temperature characteristic includes measuring at least one second instantaneous temperature point.

15. A method according to claim 1, where said change in gases' concentrations entering said catalyst is selected to compensate for catalyst deterioration so as to minimize toxic air pollutants emitted from the vehicle's tailpipe16. A method according to claim 1 whereby a third temperature characteristic of the catalyst is determined after disabling the change in exhaust gases' concentrations so as to verify catalyst temperature conditions return to those determined for the first temperature characteristic so as to confirm test condition consistency before updating a catalyst diagnostic status.

16. A method according to claim 1, whereby a third temperature characteristic of the catalyst is determined after disabling the change in exhaust gas concentrations so as to verify catalyst temperature conditions return to those determined for the first temperature characteristic so as to confirm test condition consistency before updating a catalyst diagnostic status.

17. A method according to claim 1, wherein the catalyst is coupled to an engine and the diagnostic test is performed with stabilized engine conditions by use of a device for electrically controlling engine airflow change based upon operator power demands.

18. A method according to claim 1, wherein the characteristics for determining whether the condition of said catalytic converter is malfunctioning are modified based upon determined characteristics from at least one catalyst temperature sensor following cold engine starting.

19. A method according to claim 1, whereby the characteristics for determining whether the condition of said catalyst is malfunctioning are modified based upon monitoring an output of one

or more oxygen sensor(s) while controlling temporary changes in gases' conditions to provide detectable changes in the oxygen sensor(s) output.

20. A method of catalytic converter diagnostics, including the steps of:

detecting during a first time period a first engine operational condition and at least one engine parameter indicating consistent diagnostic results are obtainable;

enabling changes to conditions of selected individual engine cylinders, differing from the first engine operational condition, for causing cycling of exhaust air-fuel ratio characteristics during a second time period; and

monitoring catalyst temperature change occurring between the first time period and the second time period so as to determine if the catalytic converter is malfunctioning.

21. A method according to claim 20, wherein the step of enabling changes is accomplished by operating selected individual cylinders under rich conditions while introducing oxygen into engine exhaust gases entering the catalytic converter so as to cause the catalyst temperature changes.

22. A method according to claim 21, wherein the introducing oxygen into the exhaust gases is accomplished using electronically controlled engine valves and a system for causing pressures in an engine intake manifold to exceed those in an engine exhaust manifold.

23. A method according to claim 20, whereby the catalytic converter diagnostic test is performed with stabilized engine conditions by use of a device for electrically controlling engine airflow changes based upon operator power demands.

24. A method of early cycling an oxygen sensor's output during non-stoichiometric cold start conditions, including the steps of:

monitoring engine exhaust gases with an oxygen sensor,

detecting at least one parameter indicating engine operation outside a stoichiometric control range after a cold start;

enabling a change in fuel quantity to at least one selected individual cylinder, such quantity estimated to cause a defined oxygen sensor output change;

modifying said quantity estimated for said change in fuel to subsequent selected individual cylinder(s) until causing a defined change in said oxygen sensor's output,

and repeating the steps for enabling a change and modifying the quantity so as to cause repetitive cycling of the oxygen sensor output about a defined threshold until at least one engine parameter reaches a predetermined value.

25. A method according to claim 24, whereby repetitive cycling of the oxygen sensor's output during non-stoichiometric conditions following cold engine starting is used to assess catalytic converter operation.

26. A method according to claim 24, whereby the repetitive cycling an oxygen sensor's output is caused by enabling changes in fuel quantity to multiple selected individual cylinders for causing the output of an oxygen sensor monitoring engine exhaust gases to fluctuate about a defined control point.

27. A method according to claim 24, whereby said repetitive cycling an oxygen sensor's output is used to confirm initiation of catalyst chemical exothermic activity by monitoring outputs of a first oxygen sensor located before a catalytic converter and a second oxygen sensor located after the catalytic converter.

28. A method of early cycling an oxygen sensor's output during non-stoichiometric cold start conditions, including the step of:

enabling a change in fuel quantity to at least one selected individual cylinder that will cause the output of the oxygen sensor monitoring engine exhaust gases to traverse a defined control point.

29. A method for increasing heating rates of a catalytic converter after cold engine starting including:

providing at least one temperature sensor coupled to the catalytic converter;

detecting at least one operational condition determining initiation of catalyst chemical exothermic activity;

controlling changes in exhaust gases' concentrations entering said catalyst, so as to provide chemical conditions sufficient for increasing the rate of catalyst heating.

30. A method according to claim 29, wherein said determining initiation of catalyst chemical exothermic activity is provided from catalyst temperature characteristics.

31. A method according to claim 30, wherein said determining initiation of catalyst chemical exothermic activity provided from catalyst temperature characteristics includes derivatives of said temperature characteristics with respect to time.

32. A method according to claim 30, wherein said determining initiation of catalyst chemical exothermic activity is provided by detecting changes in exhaust gases' concentrations from at least one gas sensor positioned to detect gases exiting said catalytic converter.

33. A method according to claim 30, wherein said determining initiation of catalyst chemical exothermic activity is confirmed by monitoring outputs of a first oxygen sensor located before the catalytic converter and a second oxygen sensors located after the catalytic converter, while controlling temporary changes in exhaust gases' conditions to provide detectable changes in the oxygen sensor outputs.

34. A method according to claim 30, wherein the step of controlling changes in exhaust gases' concentrations includes controlled changes being based upon prior determinations of catalytic converter conversion efficiency performance.

35. A method according to claim 30, wherein the step of controlling changes in exhaust gases' concentrations entering said catalyst includes enabling controlling

changes, before said step of determining initiation of catalyst chemical exothermic activity, based upon stored engine parameter values from prior engine cold starts.

36. A method according to claim 30, wherein detecting at least one operational condition occurs prior to entering stoichiometric engine operation after a cold start, and controlling changes in exhaust gases' concentrations entering said catalyst is implemented after initiation of catalyst chemical exothermic activity.

37. A method according to claim 30, wherein during said step of controlling changes in exhaust gases' concentrations, the controlled changes are modified based upon prior determinations of at least one engine parameter following cold start conditions in order minimize toxic air pollutants.

38. A method according to claim 30, further including the step of:

measuring at least one engine operational condition indicating catalyst temperature conditions are approaching defined values and disabling changes so as to cause increased rate of catalyst heating.

39. A method according to claim 30, wherein during the step of said controlling changes in exhaust gases' concentrations, the controlled changes are modified to allow A/F cycling operation at any defined average A/F ratio by using a wide range linear type oxygen sensor for engine feedback control.

40. A method according to claim 30, wherein said determining initiation of catalyst chemical exothermic activity is made more discernable using catalyst temperature characteristics by selection of particular catalytic converter design characteristics.

41. A method according to claim 30, wherein during said step of controlling changes in exhaust gases' concentrations, the controlled changes are modified based upon prior determinations of catalytic converter condition.

42. A method according to claim 30, wherein said step of controlling changes in exhaust gases' concentrations entering catalyst is enabled after a specified change in at least one engine control parameter, the specified change occurring following said determining initiation of catalyst chemical exothermic activity.

43. A method of heating a catalytic converter of an internal combustion engine, comprising the steps of:

providing at least one temperature sensor in said catalytic converter;

sensing at least one condition sufficient for determining a starting point of exothermic chemical reactions within the said catalytic converter ; and

changing quantities of chemically reactive gases entering said catalytic converter so as to increase the rate of catalyst heating to a temperature sufficient to reduce pollutants exiting said catalytic converter.

44. A method according to claim 43, wherein said step of changing quantities of chemically reactive gases entering said catalytic converter includes varying fuel quantities input to selected engine cylinders of said internal combustion engine.

45. The method according to claim 43, wherein prior determined results from said step of sensing of conditions producing exothermic chemical reactions are used to modify the selected magnitudes of exhaust gases' air-fuel ratios.

46. The method according to claim 43, wherein results from prior determinations of the catalytic converter's condition are used to modify both the starting point for said changing quantities of chemically reactive gases and their magnitudes to heat the catalyst.

47. A method according to claim 43, wherein said one condition sufficient for determining initiation of said heating includes compensation for catalyst temperature changes caused by operator power demands, by use of a system having a catalyst temperature modeling algorithm integrated with a device for allowing electrically controlled engine airflow changes based upon operator power demands within a defined range, as a result of using in order to control airflow condition changes for improving temperature modeling algorithms in the actual determination of the starting point of exothermic chemical reactions.

48. A method according to claim 47, wherein said filtering of driver power demands after engine cold starts is used to improve estimates of expected catalyst temperature changes from said temperature modeling.

49. A method according to claim 47, wherein said filtering of driver power demands after engine cold starts is used to improve discerning the starting point of initiation of catalyst exothermic heating.

50. A method for compensating for engine power changes caused by controlled changes in the quantity of residual exhaust gases entering an engine's cylinder, comprising the step of:

providing a device for electrically controlling engine airflow changes; and

controlling said device to maintain defined conditions in operator power demands by use of specified conditions stored in memory.

51. A method of reducing undesired gases' emissions from a catalyst coupled to an internal combustion engine and a temperature sensor coupled to the catalyst, including the steps of:

monitoring the catalyst temperature with the temperature sensor;

changing at least one operating parameter of the engine to cause the temperature of the catalyst to rapidly rise when chemical exothermic activity has started in the catalyst and engine operational condition preclude establishing stoichiometric closed loop fuel control operation ; and

changing at least one operating parameter of the engine to achieve said stoichiometric engine operation in exhaust gases when the catalyst has reach a temperature needed to establish stoichiometric closed loop fuel control engine operation.